

Project

- Connect the end of your spring scale with a partner.
- Pull with 2N of force while your partner pulls with 4 N of force.
- Describe and explain your observations.

Lesson #29

Topic: Newton's Third Law

Objectives: (After this class I will be able to)

1. State Newton's Third law of motion.
2. Describe action and reaction forces.

Warm Up: A truck driving on the interstate collides with a bug flying into the windshield. Which gets hit harder, the truck or the bug?

Assignment: Ch 4 Assessment & Wikispace Post

A truck driving on the interstate collides with a bug flying into the windshield. Which gets hit harder, the truck or the bug?

1. Bug
2. Truck
3. They both get hit with the same force.
4. I'm not sure.



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Hewitt Video

Answer the following questions on a separate sheet of paper and turn in by the end of the period.

1. For every action there is an ...
2. Does a stick of dynamite contain force?
3. Two teams playing tug of war each pull on opposite sides of a rope with a force of 400N. What does the scale in the middle of the rope read?
4. We move by _____ forces.
5. How can a sink make you weigh more or less?
6. What can we say about the force acting on a bullet compared to the reaction force acting on the gun?
7. What makes a rocket move in the vacuum of space?
8. Why can't you hit a piece of paper with 50lbs of force?
9. What is the horse's argument for not pulling the cart to market?
10. Why is the horse's argument incorrect?

Newton's Third Law

- *Whenever one object exerts a force on another object, the second object exerts an equal and opposite force back on the first object.*
- Examples:
 - You push against the wall, the wall pushes back on you with an equal amount of force.
 - Pickup truck strikes oncoming insect, insect strikes oncoming truck with an equal amount of force in the opposite direction.
 - Note: The bug will have a very large acceleration because of its small mass, and the truck will have a very small acceleration because of its large mass, but the force will be the same.

Newton's Third Law

- It is impossible for there to be an action force, without a reaction force.
- We are capable of moving by reaction forces.
- Example: Horse pushes on the ground, the ground pushes back with an equal amount of force.
- **Hmm....** So then they cancel out and the net force is zero.... But then how can a horse pull a cart?

How can a horse pull a cart?



When looking at net force, we only count the forces acting on the object not done by the object.

Project

- Observe the balloon rocket.
- Team up with a partner and discuss how the rocket moves.
- Be able to describe in terms of acceleration, net force, action force, and reaction force, the motion of the balloon.
- Draw a picture and the forces acting on the rocket to help your explanation.
- Assignment: Transparency 4-1

Impressive Elevator

- You have always been impressed by the speed of the elevators in the IDS building in Minneapolis (especially compared to the one in the Physics building). You wonder about the maximum acceleration for these elevators during normal operation, so you decide to measure it by using your bathroom scale. While the elevator is at rest on the ground floor, you get in, put down your scale, and stand on it. The scale reads 130 lbs. You continue standing on the scale when the elevator goes up, carefully watching the reading. During the trip to the 50th floor, the greatest scale reading was 180 lbs.



Lesson #30

Topic: Net force problems using Newton's Laws

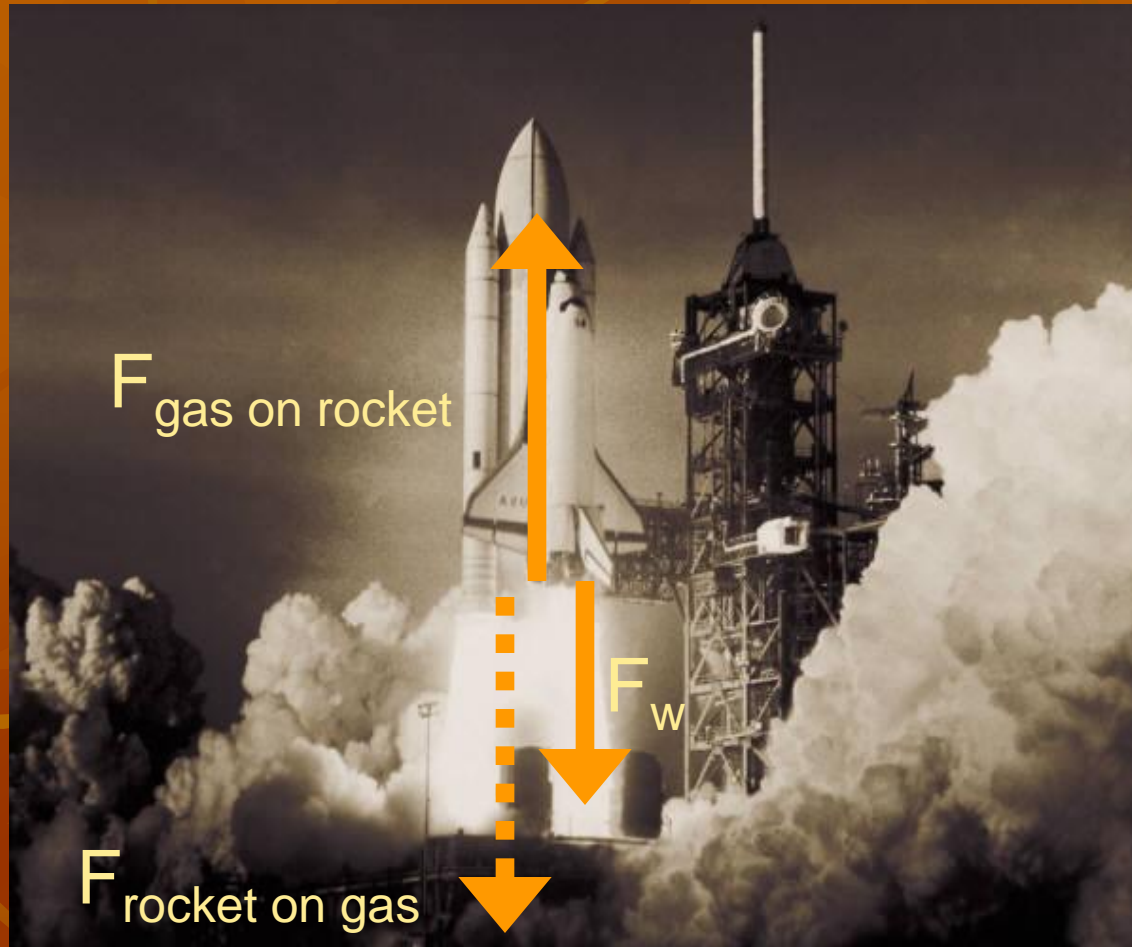
Objectives: (After this class I will be able to)

1. Find all the forces acting **on** an object and exclude forces done **by** the object.
2. Draw all forces acting **on** an object to find the net force acting on the object.

Warm Up: At takeoff, a rocket's engines exert exhaust downward with a thrust of 20000N. If the rocket has an upward acceleration of 2m/s^2 , what is the mass of the rocket?

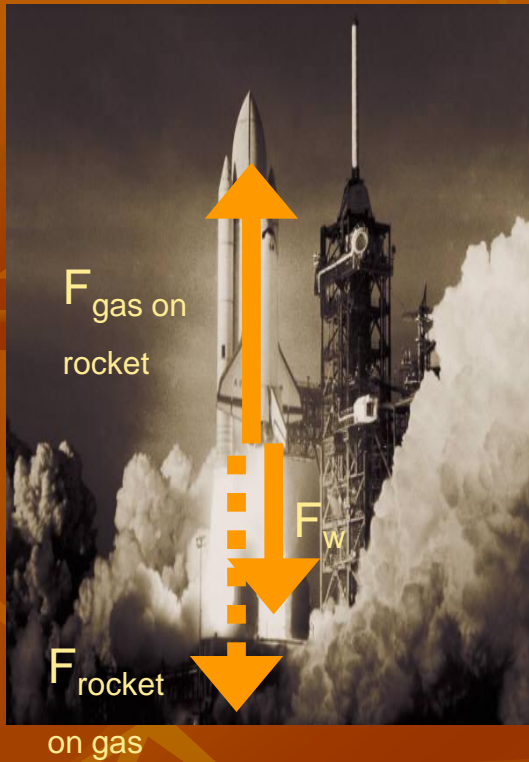
Assignment: "Ch 4 Supplemental Problems #1,2,4,5,8,10,14,16"

Warm Up Solution



Remember: We only sum up the forces acting **on** the rocket (solid lines); not those done **by** the rocket (dashed line).

Warm Up Solution



Impressive Elevator

- $11b = 2.2\text{kg}$
- Find the acceleration of the elevator
- Impressive or no? Explain.

Lesson #31

Topic: Exam 4 Review

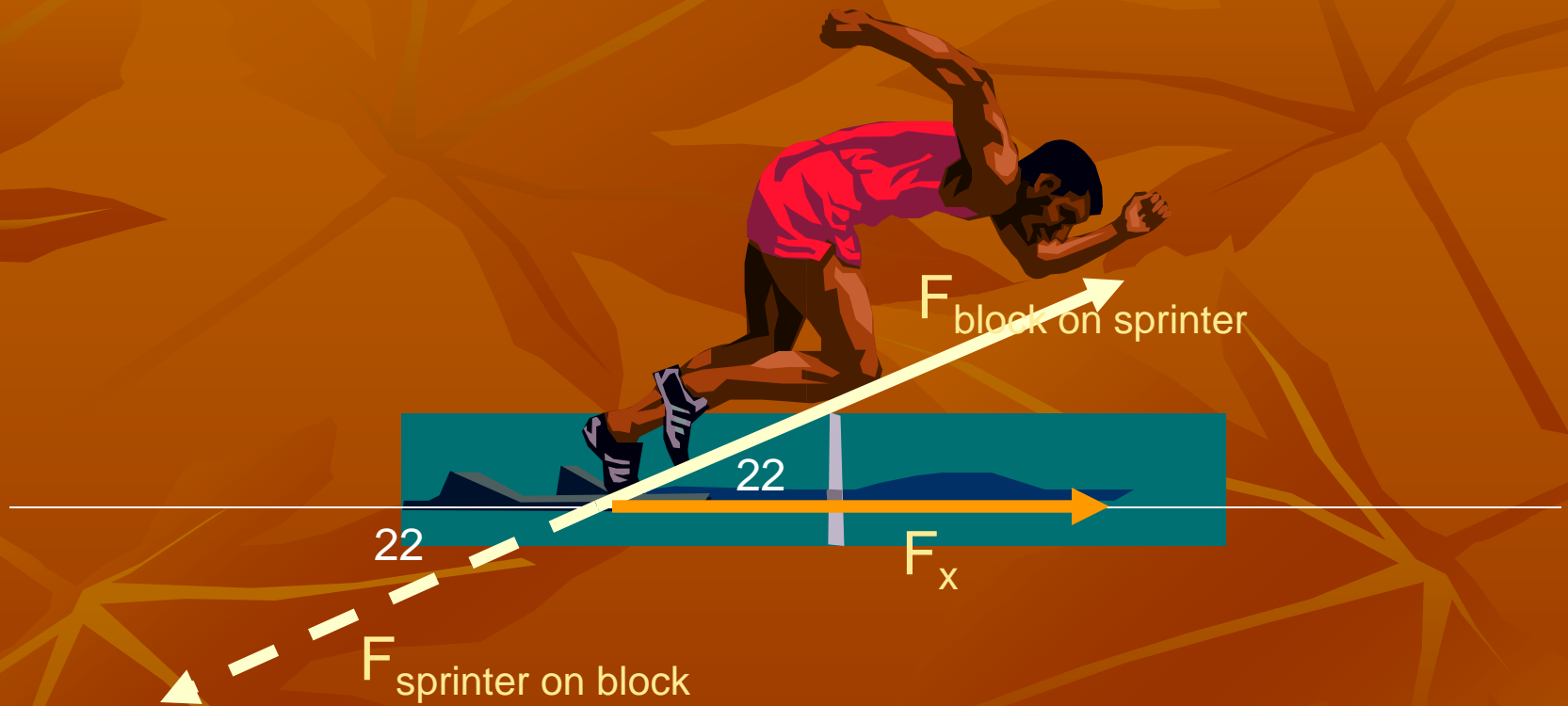
Objectives: (After this class I will be able to)

1. Practice solving physics problems
2. Complete and check Exam 4 Review
3. Plan a tutoring time (if needed)
4. Complete a bonus problem opportunity

Warm Up: At the moment the gun is fired at the start of a race, a 65kg sprinter was found to exert a force of 800N on the starting block at a 22° angle with respect to the ground. What is the horizontal acceleration of the sprinter?

Assignment: Exam 4 Review due Wednesday!
Study for Exam 4

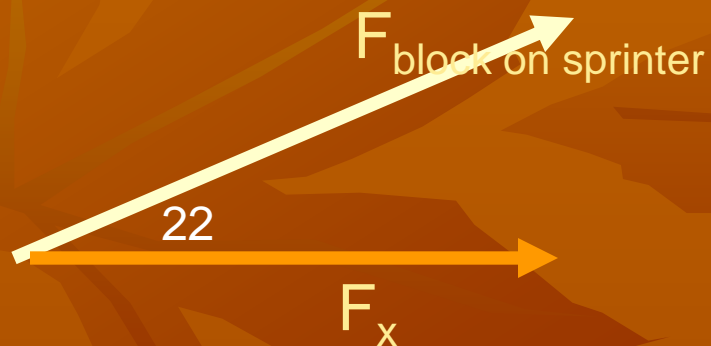
Warm Up Solution



Since the problem asks for **horizontal** acceleration, we will only worry about the horizontal forces acting **on** the sprinter.

For this case F_x

Warm Up Solution



Inertia is...

1. How big something is
2. Same as mass
3. Same as weight
4. The reluctance of an object to change its state of motion



How big something is

Same as mass

Same as weight

The reluctance of an...

A tennis ball and a solid steel ball are dropped at the same time. Which has the greater net force acting on it?

1. Tennis ball
2. Steel ball
3. They both have the same net force
4. Not enough information



Tennis ball

Steel ball

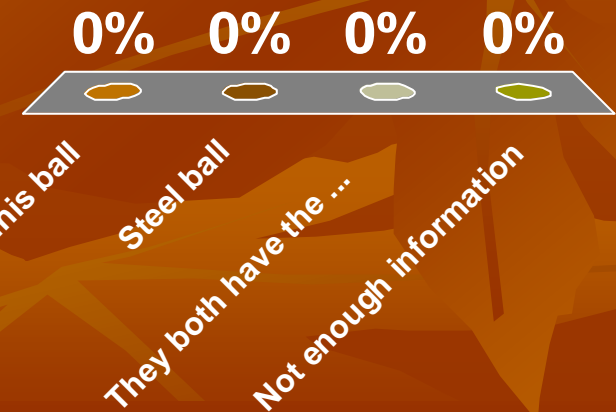
They both have the ...

Not enough information

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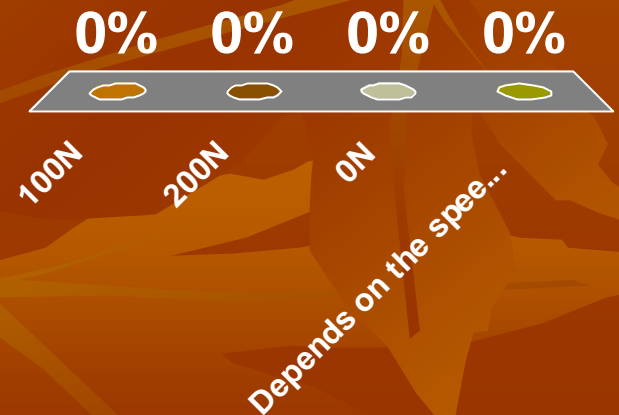
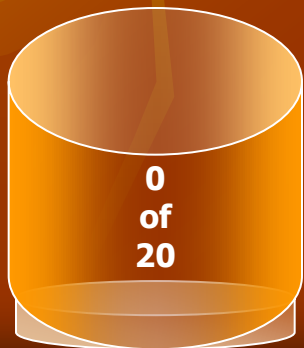
A tennis ball and a solid steel ball are dropped at the same time. Which has the greater acceleration?

1. Tennis ball
2. Steel ball
3. They both have the same acceleration
4. Not enough information



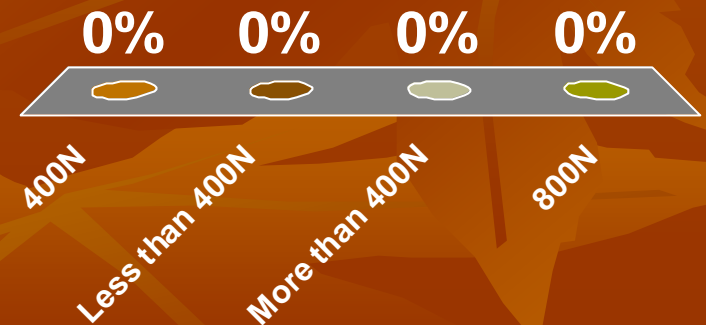
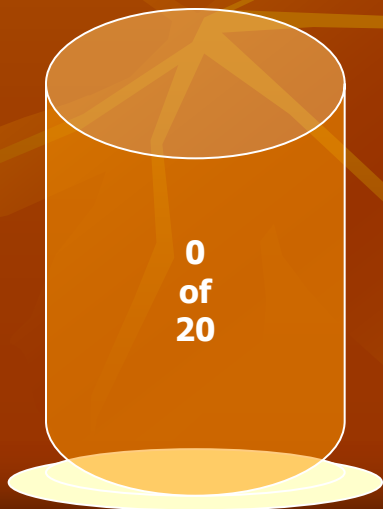
A 200N force is applied to move a crate across a warehouse floor at constant speed. The friction force acting on the crate is...

1. 100N
2. 200N
3. 0N
4. Depends on the speed of the crate

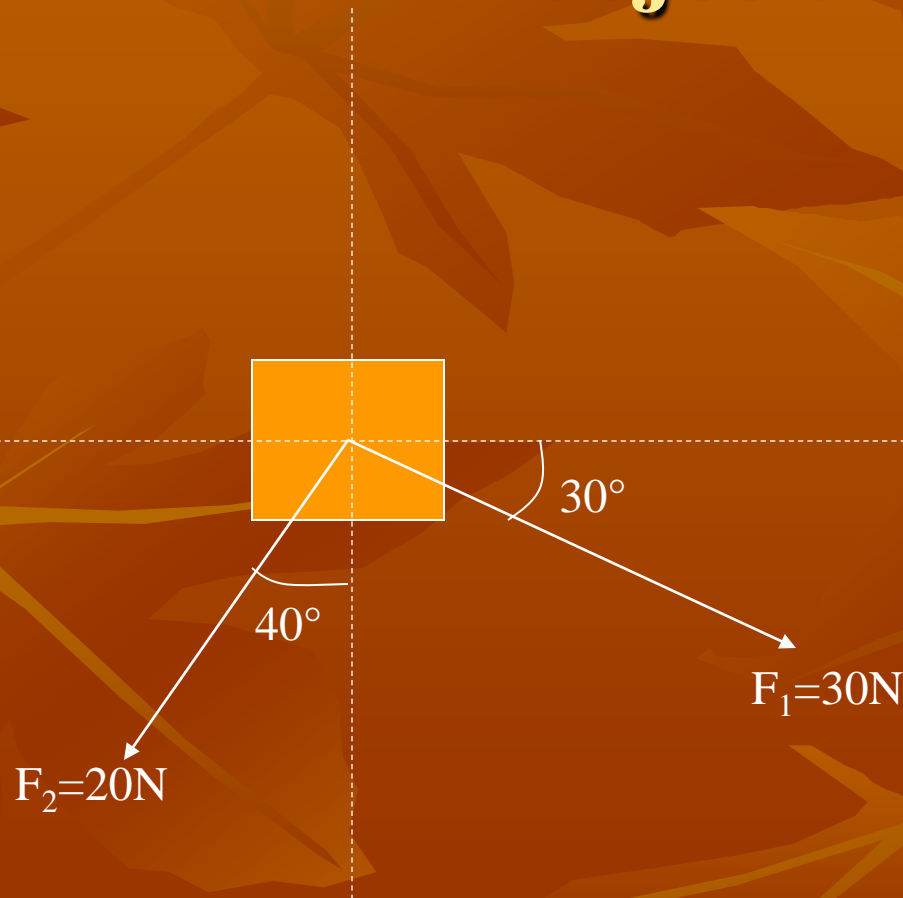


Two teams are in a tug of war. One team pulls with a force of 400N. With what force does the rope pull back on the team?

1. 400N
2. Less than 400N
3. More than 400N
4. 800N



Find the magnitude and direction of the net force acting on the following object.



Bonus

A 4160kg space probe is traveling with a speed of $v = 2170\text{m/s}$ in the direction shown in the drawing. The probe has four engines, A, B, C, and D, as indicated. Each engine delivers a thrust of 68,300N when turned on. Which engines should be fired and for how long, to change the probe so the new velocity has twice the original magnitude and points in a direction 90° clockwise relative to its original direction?

